REMARKS

Claims 1-28 are pending in this application. By this Amendment, claims 1-4 and 22 are amended. Attached hereto is a marked-up version of the changes made to the claims by the current Amendment. The attached pages are captioned "Version with Markings to Show Changes Made".

Entry of this amendment is proper under 37 C.F.R. 1.116 because the amendment : (a) places the application in condition for allowance; (b) places the application in better form for an appeal should an appeal be necessary; and (c) does not require any further search and/or consideration. More specifically, the above amendments are in direct response to issues first raised in the Final Rejection. Minor amendments have been made to the claims. The addition of the fifth step to claims 1 and 2 is based on comments in the Office Action to link the preamble to the body of the claim. Entry is proper under 37 C.F.R. § 1.116.

The Office Action rejects claims 1, 3-5, 7, 9, 11, 13, 15 and 17-28 under 35 U.S.C. § 112, second paragraph. It is respectfully submitted that the above-amendments to the claims obviate the grounds for rejection. In particular, "aforesaid" in claim 1 has been amended to "said". Additionally, the use of the symbol "." has been changed to proper symbol in each of claims 3, 4 and 22. Additionally, in the equation in claim 3 a "p" has been changed to a --q--. Furthermore, the referenced equation in claim 3 has been appropriately modified to correspond to that in the specification. Withdrawal of the rejection under 35 U.S.C. § 112, second paragraph is respectfully requested.

The Office Action rejects claims 1-28 under 35 U.S.C. § 101 because the claimed invention is directed to non-statutory subject matter. In particular, the Office Action asserts that the claims set forth a method of synthesizing an interframe predicted image <u>as described in the preamble</u> and thereafter recites four sets of calculations that solves a purely mathematical problem without limitation to practical application.

As set forth in the May 16th Amendment, the Federal Circuit has held that when data is taken through a series of mathematical calculations to determine a useful, concrete and tangible result, the claims comply with 35 U.S.C. § 101. The Office Action states that the calculation steps as claimed in the body of claims 1 and 2 do not show how they are being used to synthesize an interframe predicted image as defined in the respective preambles. That is, the Office Action asserts that the body of claims 1 and 2 fail to reflect or show any link to the preamble to thereby provide any useful, concrete and tangible results.

Each of claims 1 and 2 is amended to more positively link the body of the claim to the preamble. That is, independent claim 1 relates to a method of synthesizing an interframe predicted image of a current frame from a reference image. The body of claim 1 sets forth various features relating to this method (recited in the preamble) including a fifth step of calculating the pixel value of the pixel in the interframe predicted image of the coordinates (x+w, y+w) using the reference image and the motion vector calculated in the fourth step. It is clear that claim 1 interlinks both the preamble and the body of claim 1 to describe calculating a pixel value of the pixel in the interframe predicted image (which is obtained of a current frame from a reference image).

The application and the claims clearly relate to a very technological methodology of great use. That is, the present application relates to image encoding and decoding method and device. Independent claim 1 sets forth specific details of the embodiments of the present invention relating to image encoding and decoding. That is, independent claim 1 sets forth synthesizing an interframe predicted image of a current frame from a reference image. The body of the claims sets forth specific steps relating to those features including calculating the pixel value of the pixel in the interframe predicted image. As such, the respective features as set forth in claim 1 relates to a useful, concrete and tangible result. Independent claim 2 includes similar features and therefore also relates to a useful, concrete and tangible result. As such, claims 1-28 comply with 35 U.S.C. § 101.

The Office Action does not reject any of claims 1-28 over the prior art of record. As such, it is believed that claims 1-28 define patentable subject matter.

CONCLUSION

In view of the foregoing, it is respectfully submitted that the above- identified application is in condition for allowance. Favorable consideration and prompt allowance of claims 1-28 are respectfully requested.

Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, or credit any overpayment of fees, to the deposit account of Antonelli, Terry, Stout & Kraus, LLP, Deposit Account No. 01-2135 (520.37902X00).

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS

Claims 1-4 and 22 have been amended as follows.

1. (Twice Amended) A method of synthesizing an interframe predicted image of a current frame from a reference image comprising:

a first step for calculating the values of motion vectors [of] between said interframe predicted image and said reference image for four representative points at coordinates (i,j), (i+p, j), (i, j+q), (i+p, j+q) of said interframe predicted image (where i, j, p, q are integers, the horizontal and vertical components of the motion vectors of the representative points taking the values of integral multiples of 1/k where k and the hk power of 2, and hk is a non-negative integer),

a second step for calculating the motion vectors of a pixel in said interframe predicted image at coordinates (x+w, y+w) by performing bilinear interpolation/extrapolation on the motion vectors of the four representative points of an image where the pixel sampling interval in both horizontal and vertical directions is 1 and horizontal and vertical coordinates of sampling points are obtained by adding w to integers (where w=wn/wd, wn is a non-negative integer, wd is a hw power of 2, hw is a non-negative integer and wn<wd), where [the aforesaid] said second step [comprised of] comprises:

a third step for calculating the horizontal and vertical components of

motion vectors at the coordinates (i, y+w) as numerical values which are respectively integral multiples of 1/z (where z is the power of 2, and hz is a non-negative integer) by linear interpolation/extrapolation of the motion vectors of the representative points at the coordinates (i, j), (i, j+q), and for calculating the horizontal and vertical components of the motion vectors at the coordinates (i+p, y+w) as values which are respectively integral multiples of 1/z (where z is the hz power of 2, and hz is a non-negative integer) by linear interpolation/extrapolation of the motion vectors of the representative points at coordinates (i+p, j), (i+p, j+q), [and]

a fourth step for calculating the horizontal and vertical components of the motion vectors of the pixel at the coordinates (x+w, y+w) as values which are respectively integral multiples of 1/m (where m is the hm power of 2, and hm is a non-negative integer) found by linear interpolation/extrapolation of the two motion vectors at the coordinates (i, y+w), (i+p, y+w)<u>; and</u>

<u>a fifth step of calculating the pixel value of said pixel in said interframe predicted image of the coordinates (x+w, y+w) using said reference image and the motion vector calculated in said fourth step</u>.

2. (Twice Amended) A method of synthesizing an interframe predicted image <u>of a current frame from a reference image</u> comprising:

a first step for calculating the values of motion vectors [of] <u>between said interframe predicted image and said reference image for</u> four

representative points at coordinates[.] (i,j), (i+p, j), (i, j+q) (i+p, j+q) of said interframe predicted image (where i, j, p, q are integers, the horizontal and vertical components of the motion vectors of the representatives points taking the values of integral multiples of 1/k where k is the hk of power 2, and hk is a non-negative integer),

a second step for calculating the motion vectors of a pixel in said interframe predicted image at coordinates (x+w, y+w) by performing bilinear interpolation/extrapolation on the motion vectors of four representative points of an image where the pixel sampling interval in both horizontal and vertical directions is 1 and horizontal and vertical coordinates of sampling points are obtained by adding w to integers (where w=wn/wd, wn is a non-negative integer, wd is a hw power of 2, hw is a non-negative integer and wn<wd), where the second step [comprised of] comprises:

a third step for calculating the horizontal and vertical components of motion vectors at the coordinates (x+w, j) as numerical values which are respectively integral multiples of 1/z (where z is the hz power of 2, and hz is a non-negative integer) by linear interpolation/extrapolation of the motion vectors of the representative points at the coordinates (i, j), (i+p, j), and for calculating the horizontal and vertical components of the motion vectors at the coordinates (x+w, j+q) as values which are respectively integral multiples of liz (where z is the hz power of 2, and hz is a non-negative integer) by linear

interpolation/extrapolation of the motion vectors of the representative points at coordinates (i, j+q), i+p, j+q), [and]

a fourth step for calculating the horizontal and vertical components of the motion vectors of the pixel at the coordinates (x+w, y+w) as values which are respectively integral multiples of 1/m (where m is the hm of power 2, and hm is a non-negative integer), found by linear interpolation/extrapolation of the two motion vectors at the coordinates (x+w, j), (x+w, j+q); and

a fifth step of calculating the pixel value of said pixel in said interframe predicted image of the coordinates (x+w, y+w) using said reference image and the motion vector calculated in said fourth step.

3. (Twice Amended) A method of synthesizing an interframe prediction image according to Claim 1, wherein, when the motion vectors of a pixel at the coordinates (x+w, y+w) are found using (u0, v0), (u1, v1), (u2, v2), (u3, v3), which are the horizontal and vertical components of the motion vectors of the representative points at the coordinates (i,j), (i+p, j), (i, j+q), (i+p, j+q) multiplied by k, (uL(y+w), vL(y+w)) which are the horizontal and vertical components of the motion vectors at a point having the coordinates (i, y+w) multiplied by z, are found by calculating:

[uL (y+w) = (((q. wd – (y-i).wd-
wn) u0 + (y-i).wd + wn) u2)z)////(q.k.wd),
vL(y+w)=(((q.wd-(y-i).wd-
wn) v0+(y-i).wd+wn) v2) z)////(q.k.wd)]

uL (y+w) = (((q·wd – (y-j)·wd-
wn) u0 + ((y-j)·wd + wn) u2)z)////(q·k·wd),
vL(y+w)=(((q·wd-(y-j)·wd-

wn) v0+((y-j)·wd+wn) v2) z)////(q·k·wd)

(where [////] is a division wherein the computation result is rounded to the nearest integer when the result of an ordinary division is not an integer, and the order of computational priority is equivalent to multiplication and division),

(uR(y+w), vR(y+w)) which are the horizontal and vertical components of the motion vector at a point having the coordinates (i+p, y+w) multiplied by z, are found by calculating:

[uR(y+w)=(((q.wd-(y-i).wd-
wn) u1 + ((y-i).wd+wn) u3) z) //// (q.k.wd)
vR (y+w)=(((p.wd-(y-i).wd-
wn) v1 + ((y-i).wd+wn)v3)z)////(q.k.wd)]

uR(y+w)=(((q·wd-(y-j)·wd-
wn) u1 + ((y-j)·wd+wn) u3) z) //// (q·k·wd)
vR (y+w)=(((q·wd-(y-i)·wd-
wn) v1 + ((y-j)·wd+wn)v3)z)////(q·k·wd), and

(u(x+w), y+w), v(x+w, y+w)) which are the horizontal and vertical components of the motion vector of a pixel at the coordinates (x+w, y+w) multiplied by m, are found by calculating:

[u(x+w, y+w)=(((p.wd-(x-i).wd-
wn) uL (y+w)+((x-i).wd+wn) uR(y+w))m)//(p.z.wd)
v(x+w, y+w)=(((p.wd-(x-i).wd-
wn) vL (y+w) + ((x-i).wd+wn)vR) (y+w))m)//(p.z.wd)]

u(x+w, y+w)=(((p·wd-(x-i)·wd-
wn) uL (y+w)+((x-i)·wd+wn) uR(y+w))m)//(p·z·wd)
v(x+w, y+w)=(((p·wd-(x-i)·wd-
wn) vL (y+w) + ((x-i)·wd+wn)vR (y+w))m)//(p·z·wd)

(where [//] is a division wherein the computation result is rounded to the nearest integer when the result of an ordinary division is not an integer, and the order of priority is equivalent to multiplication and division).

4. (Twice Amended) A method of synthesizing an interframe predicted image according to claim 2, wherein, when the motion vectors of a pixel at the coordinates (x+w, y+w) are found using (u0, v0), (u1, v1), (u2, v2), (u3, v3), which are the horizontal and vertical components of the motion vectors of the representative points at the coordinates (i, j), (i+p, j), (i, j+q), (i+p, j+q) multiplied by k,

(uT(x+w), vT(x+w)), which are the horizontal and vertical components of the motion vectors at a point having the coordinates (x+w, j) multiplied by z, are found by calculating:

[uT(x+w)=(((p.wd-(x-i).wd-
wn) u0+((x-i).wd+wn)u1)z)////(p.k.wd),
vT (x+w)=(((p.wd-(x-i).wd-
wn) v0+((x-i).wd+wn)v1)z)////(p.k.wd)]

uT(x+w)=(((p·wd-(x-i)·wd-
wn) u0+((x-i)·wd+wn)u1)z////(p·k·d),
vT (x+w)=(((p·wd-(x-i)·wd-
wn) v0+((x-i)·wd+wn)v1)z)////(p·k·wd)

(where [////] is a division wherein the computation result is rounded to the nearest integer when the result of an ordinary division is not an integer, and the order of computational priority is equivalent to multiplication and division),

(uB(y+w), vB(y+w)) which are the horizontal and vertical components of the motion vectors at a point having the coordinates (x+w, j+p)

multiplied by z, are found by calculating:

[uB(x+w)=(((p.wd-(x-i).wd- wn)u2+((x-i).wd+wn)u3)z)////(p.k.wd),

vB(x+w)=(((p.wd-(x-i).wd-wn)v2+((x-i).wd+wn)v3)z)////(p.k.wd)]

uB(x+w)=(((p·wd-(x-i)·wd-wn)u2+((x-i)·wd+wn)u3)z)////(p·k·wd),

vB(x+w)=(((p·wd-(x-i)·wd- wn)v2+((x-

i)·wd+wn)v3)z)////(p·k·wd), and

(u(x+w), y+w), v(x+w, y+w)) which are the horizontal and vertical components of the motion vectors of a pixel at the coordinates (x+w, y+w) multiplied by m, are found by calculating:

[u(x+w, y+w)=(((q.wd-(y-i).wd-wn)uT(x+w)+((y-i)
.wd+wn)uB(x+w))m)//(q.z.wd)
v(x+w, y+w)=(((q.wd-(y-i).wd-
wn)vT(x+w)+ ((y-i).wd+wn)vB(x+w))m)//(q.z.wd)]

u (x+w, y+w)=(((q·wd-(y-j)·wd-wn)uT(x+w)+((y-
j)·wd+wn)uB(x+w))m)//(q·z·wd)
v(x+w, y+w)+(((q·wd-(y-j)·wd-
wn)vT(x+w)+ ((y-j)·wd+wn)vB(x+w))m)//q·z·wd)

(where [//] is a division wherein the computation result is rounded to the nearest integer when the result of an ordinary division is not an integer, and the order of priority is equivalent to multiplication and by division).

22. (Twice Amended) A method of synthesizing an interframe predicted images according to Claim 1, wherein,

when the number of pixels in the horizontal and vertical directions of the image is respectively r and s (wherein r and s are positive integers), and

the pixels of the image lie in a range wherein the horizontal coordinate is from 0 to less than r and the vertical coordinate is from 0 to less than s, (u0, v0), (u1, v1), (u2, v2), (u3, v3) which is expressed by

[u'(x, y)=(((s.cd-cn-y.cd)((r.cd-cn-x.cd)u00 + (x.cd+cn)u01) + (y.cd+cn) ((r.cd-cn-x.cd)u02+(x.cd+cn)u03))k) ///(r.s.n.cd),

v'(x, y)=(((s.cd-cn-y.cd)((r.cd-cn-x.cd)v00 +(x.cd+cn)v0l)+ (y.cd+cn) ((r.cd-cn-x.cd)v02+(x.cd+cn)v03))k)///(r.s.n.cd)]

u' (x, y)=(((s·cd-cn-y·cd)((r·cd-cn-x·cd)u00 + (x·cd+cn)u01 + (y·cd+cn) ((r·cd-cn-x·cd)u02+(x·cd-cn)u03))k)///(r·s·n·cd),

v'(x, y)=(((s·cd-cn-y·cd)((r·cd-cn-x·cd)v00 +(x·cd+cn)v01)+ (y·cd+cn) ((r·cd-cn-x·cd)v02+(x·cd+cn)v03))k)///(r·s·n·cd),

u0=u' (i, j)
v0=v' (i, j)
u1=u' (i+p, j)
t1=v' (i+p, j)
u2=u' (i, j+q)
u2=v' (i, j+q)
u3=u' (i+p, j+q)
u3=v' (i+p, j+q)

(where is a division wherein the computation result is rounded to the nearest integer when the result of an ordinary division is not an integer, and the order of priority is equivalent to multiplication and division), are used as the k times horizontal and vertical components of motion vectors of representative points (i,j), (j+p, j), (i, j+q), (i+p, j+q), by using (u00, v00), (u01, v01), (u02, v02), (u03, v03) (where u00, v00, u01, v01, u02, v02, u03, v03 are integers), which are n times (where n is a positive integer) motion vectors at the corners of an image situated at the coordinates (-c, -c), (r-c, -c), (-c, s-c), (r-c, s-c) (where c=cn/cd, cn is a non-negative integer, cd is a positive integer and cn<cd), whereof the horizontal and vertical components take the values of integral multiples of 1/n.